16-30 Watt Ku-Band BUC

High Power Transmitter Module

Operation and Maintenance Manual

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Mitec telecom inc.

Designers and manufacturers of telecom and wireless products

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OPERATION AND MAINTENANCE MANUAL	Preliminary ☐	Released ☒

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TITLE:

16 to 30 Watt, 70 dB Gain, Ku Band ODU High Power Transmitter Module

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Preface

Scope

This document covers the installation, operation, and maintenance of the 16 to 30 Watt, 70 dB Gain, Ku Band ODU High Power Transmitter Modules. It contains information intended for engineers, technicians and operators working with the transmitter module.

This document covers the following model in the 16 to 30 Watt Ku Band family.

Model	Power Level
WTX-14014542-70-ES-xx	16 Watts
WTX-14014543-70-ES-xx	20 Watts
WTX-14014544-70-ES-xx	25 Watts
WTX-14014545-70-ES-xx	30 Watts
WTX-13714542-70-ES-xx	16 Watts
WTX-13714543-70-ES-xx	20 Watts
WTX-13714544-70-ES-xx	25 Watts

Note: -xx stands for configuration i.e. -25, -26, -33, -35, -37 etc.

Note: The 30W Extended Ku Band version not available for this size PA. For 30 Extended Ku Band option see the 40 to 50 W Ku band BUC series.

To make inquiries, or to report errors of fact or omission in this document, please contact **Mitec telecom inc**. at (514) 694-9000.

IMPORTANT

Important information concerning the operation and care of this product, as well as safety of authorized operators is highlighted throughout this document by one of the following labels:

NOTE

Indicates a reminder, a special consideration, or additional information that is important to know.

CAUTION!

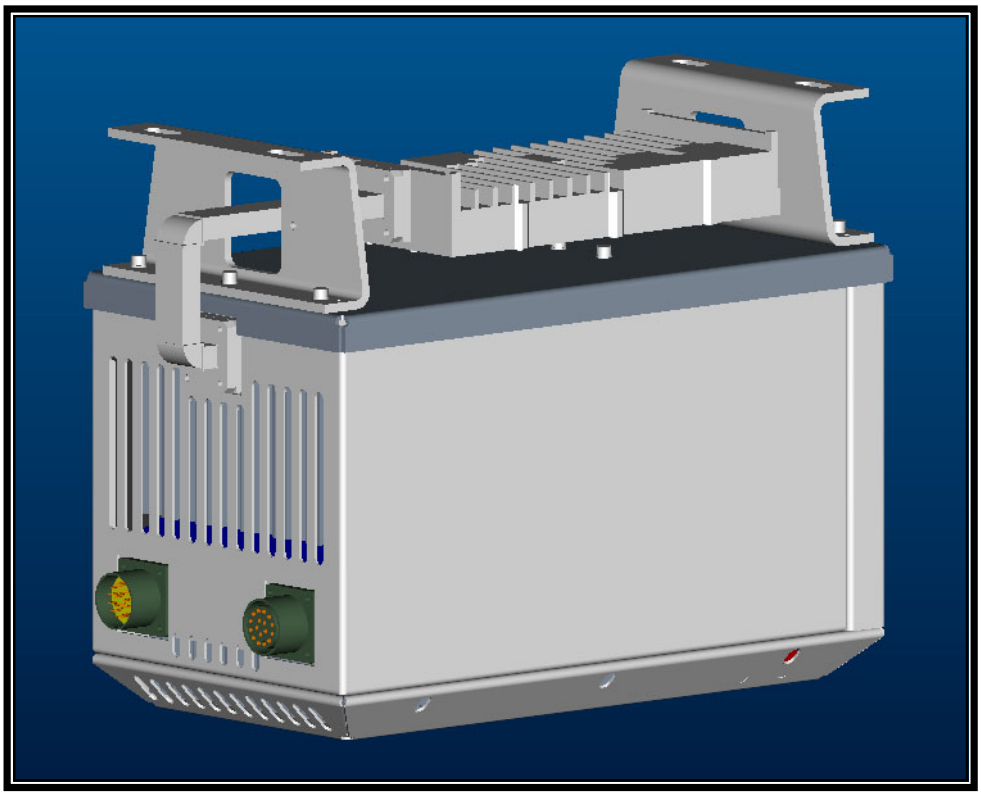
Identifies situations that have the potential to cause equipment damage.

WARNING!!

Identifies hazardous situations that have the potential to cause equipment damage as well as serious personal injury.

1 Introduction

The 16 to 30 Watt, 70 dB Gain, Ku Band ODU High Power Transmitter Modules are highly reliable, high quality, cost efficient stand-alone transmitter systems. The application for these modules is Ku-Band VSAT communication in an outdoor environment. This line of superior products, engineered using state of the art technology, is characterized by unparalleled durability and dependability. The output operating frequency range is the standard Ku-Band of 14.0 GHz to 14.5 GHz or the low extended Ku-Band of 13.75 GHz to 14.5 GHz. However, optional operating frequency ranges are also available to suite the customer's specification. Refer to Table 1.



1.1 Receiving and Inspection

The transmitter module is designed to function outdoors and will arrive in a standard shipping container. Immediately upon receipt of the transmitter module, check the Bill of Lading against the actual equipment you have received. Inspect the shipping containers exteriors for visible damage incurred during shipping.

CAUTION!

Handle the transmitter module with extreme care. Excessive shock may damage transmitter module's delicate internal components.

NOTE

Before unpacking the shipping containers, move them near to the site where the system will be mounted. Ensure that the containers are oriented correctly in accordance with the "This Side UP "labels. Carefully remove the transmitter module and packing material from the shipping containers.

Using the supplied packing list, verify that all items have been received and undamaged during shipment. Verify that all items are complete. If there are any omissions or evidence of improper packaging, please notify **Mitec telecom inc.** immediately.

1.1.1 Equipment Damage or Loss

Mitec Telecom Inc. is not responsible for damage or loss of equipment during transit. For further information, contact the responsible transport carrier.

When declaring equipment as damaged during transit, preserve the original shipping cartons to facilitate inspection reporting.

1.1.2 Return of Equipment

When returning equipment to **Mitec** for repair or replacement:

1. Identify, in writing, the condition of the equipment,
2. Refer to the sales order, Purchase Order and the date the equipment was received.

Notify Mitec Sales Administration Department of the equipment condition and obtain a Return Material Authorization (RMA) number and shipping instructions. Mitec will pay for the cost of shipping the product to the customer after the repairs are completed.

NOTE

Do not return any equipment without an RMA number. *This is important for prompt, efficient handling of the returned equipment and of the associated complaint.*

1.2 Preparing for Installation

Before attempting to install or use the transmitter module, we recommend that you first familiarize yourself with the product by reading through this manual. Understanding the operation of the system will reduce the possibility of incorrect installation, thereby causing damage or injury to yourself or others.

*The transmitter module **must** be installed in accordance with the conditions and recommendations contained in the following sections.*

When you are ready to begin your installation, use the information in Chapter 2 (Installation) as a guide for making all the required electrical connections.

1.2.1 Safety Precautions

Carelessness or mishandling of the transmitter module may damage the unit causing serious injury to yourself or others. Please adhere to the following:

WARNING!!

This unit is equipped with an AC power cord and plug. Do not tamper with, or attempt to reconfigure, the cord or plug supplied with the unit, as this can:

- *result in personal injury*
- *void the warranty*
- *cause damage to the units or related equipment.*

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2 Installation & Overview

2.1 General Description

This section describes the installation and theory of operation of the transmitter module.

The module is a stand-alone Transmitter System powered from 24 VDC and 110/220 VAC power sources. It will amplify an input signal from an L-Band RF source up to a power level of 16-20-25 Watts CW in Ku-Band.

The Transmitter consists of a low power block up-converter (BUC) and a high power amplifier (Booster.)

The Booster has control and protection functions and consists of these major sub-systems: the RF Amplifier, and power supply and a cooling system. The amplifier section contains all the necessary DC power conditioning circuitry for bias and sequencing of the RF amplifier devices as well as a RS-485 monitor and control interface.

The module can be used as a stand-alone unit or in a redundant configuration.

2.2 Specifications

Table 1 summarizes the specifications of the 16 to 30 Watt, 70 dB Gain, Ku Band ODU High Power Transmitter Modules. Where specifications differ between different frequency band options, it is noted in the table below, where:

yy = power in dBm
xx = configuration

For mechanical specifications, refer to the outline drawings, Figure 4 and 5 in Appendix A.

Table 1 –Specifications

RF Performance	
Output Frequency WTX-140145yy-70-ES-xx WTX-137145yy-70-ES-xx	 Standard Ku-Band: 14.0 to 14.5 GHz Low Extended Band: 13.75 to14.5 GHz
IF Frequency WTX-140145yy-70-ES-xx WTX-137145yy-70-ES-xx	 Standard Ku-Band: 950 to 1450 MHz Low Extended Band: 950 to 1700 MHz
LO Frequency WTX-140145yy-70-ES-xx WTX-137145yy-70-ES-xx	 Standard Ku-Band: 13.05 MHz Low Extended Ku-Band: 12.8 MHz
Reference Frequency	10 MHz External Reference; (0 ± 5) dBm Input Power Level
Small Signal Gain	70 dB, min over temperature
Gain Flatness (small signal) at 10 dB back-off	± 2.0 dB, typ. (±2.5 dB max) over full band ± 0.3 dB, p-p, max. over any 40 MHz
Gain Stability with power (expansion)	0.5 dB, max.
Output Power WTX-14014542-70-ES-xx WTX-13714542-70-ES-xx WTX-14014543-70-ES-xx WTX-13714543-70-ES-xx WTX-14014544-70-ES-xx WTX-13714544-70-ES-xx WTX-14014545-70-ES-xx	 42.0 dBm (16 W), min at P1dB 42.0 dBm (16 W), min at P1dB 43.0 dBm (20 W), min at P1dB 43.0 dBm (20 W), min at P1dB 44.0 dBm (25 W), min at P1dB 44.0 dBm (25 W), min at P1dB 45.0 dBm (25 W), min at P1dB
Saturated Output Power WTX-14014542-70-ES-xx WTX-13714542-70-ES-xx WTX-14014543-70-ES-xx WTX-13714543-70-ES-xx WTX-14014544-70-ES-xx WTX-13714544-70-ES-xx WTX-14014544-70-ES-xx	 43.0 dBm (20 W), typ. at PSAT 43.0 dBm (20 W), typ. at PSAT 44.0 dBm (25 W), typ. at PSAT 44.0 dBm (25 W), typ. at PSAT 45.0 dBm (30 W), typ. at PSAT 45.0 dBm (30 W), typ. at PSAT 46 dBm (40 W), typ. at PSAT
3rd Order Intermodulation (IMD-3)	-30 dBc typ., two equal signals at 6 dB back off from P1dB rated total; 4 MHz separation
Phase Noise	-60 dBc/Hz, max. @300 Hz offset of the carrier -70 dBc/Hz, max. @ 1 kHz offset of the carrier -80 dBc/Hz, max. @ 10 kHz offset of the carrier -90 dBc/Hz, max. @ 100 kHz offset of the carrier -100 dBc/Hz, max. @ 1 MHz offset of the carrier
Source & Load VSWR	1.5:1 max (operational), infinite at any angle without damage, unconditionally stable
Input Return Loss (cold)	-14 dB typ.
Output Return Loss	-16 dB max.

RF Performance	
Spurious In-band	-50 dBc, max @ P1dB
Spurious Out of Band	-60 dBc, max @ P1dB
Harmonics	-55 dBc, typ. @ P1dB
RF Monitor Port (optional)	N/A
Power Consumption	300 W nominal
Controls	
Gain	N/A
Mute In S/W	Via RS-485
Mute In H/W	TTL high – muted
Over Temperature Shutdown	(82 –2/+3) C at case temperature, internally set
Indicators	
RF Forward Power	Via RS-485
RF Reverse Power	N/A
RF On	N/A
Over Temperature	Via RS-485
Alarm Summary	TTL high – operational (optional)
Temperature Sensor	Via RS-485
Power Supply	
Input	110/220 VAC, 300W min.
Output	N/A
Cooling	Forced Air
Auxiliary	12 VDC, 3.5 A (optional)
Efficiency	85% nominal
Design Technology	High frequency switching modules
Mechanical Specifications	
Package	Outdoor, weather resistant
Size (overall dimensions	13”x12”x8”
Weight	11.5 Kg (24 lb) typical
Cooling	Forced Air
Exterior Surface Finish	Painted off-white
Hardware	Stainless Steel
O-ring	Silicone
Markings	**Labels permanent and legible**
1	Mitec Part No & Revision Level
2	Serial No.
3	IF Input
4	RF Output
5	RS-485 or RS-232
6	AC Input

Environmental	Operational	Storage
Temperature	-40° to 55°C	-50°C to 85°C
Humidity	5% to 95% at –40°C	5% to 95% at 65°C
Altitude	10,000 ft AMSL	40,000 ft AMSL
Shock and Vibration	Normal transport and handling	
Drop	N/A	1m in shipping container
Reliability		
MTBF (mean time between failures)	100,000 hours (fan reliability data is not included. Fan must be replaced once every 2 years minimum.	

2.2.1 General Considerations

The module shall meet all specifications over full bandwidth and under all environmental conditions when terminated with a load of VSWR at 1.5:1 unless otherwise specified. All RF specifications shall be met within five minutes after applying DC power, except gain flatness, which shall be met after a warm-up period of ten minutes. During the warm-up period, the module shall not exhibit any alarm or require an RF mute input signal to reset any alarm/fault latches.

2.3 Basic Mechanical Characteristics

2.3.1 External View of the Transmitter Module

The physical external dimensions of the transmitter module are shown in and Table 1. All inputs and outputs are shown in and described in Appendix C.

2.3.2 Connections and Mounting Hardware

The IF input connection requires a coaxial cable with an N-type male connector for the IF Input. The RF output requires a waveguide with a WR75 flat flange. An O-ring shall be used to seal the waveguide connection. There are also two cylindrical connectors on the RF Input side of the RF amplifier for AC power and M&C interface. The pin assignments for these connectors are shown in section 3. Two sets of U-bolts (2 per set) and corresponding nuts are shipped with the transmitter to fasten it to the antenna boom. The customer should choose the appropriate U-bolt set, depending on the shape of the antenna boom. See Figure 4 or 5 in Appendix A. Four cap screws (#6-32) and their respective lock washers fasten the antenna waveguide feeder on to the transmitter waveguide output flange. The mating connectors, hardware and O-ring are in the shipping container with the transmitter.

2.4 Assembly and Installation

Use the information in this section as a guide to assemble and install the transmitter module. The specified humidity is up to 100% during operation. However, installation should be carried out in dry conditions, free of salt spray or excessive humidity. This will eliminate the possibility of moisture and other foreign substances from entering the output waveguide flange.

CAUTION!

Only authorized technical personnel should perform the Installation and proper electrical hookups of the transmitter module.

2.4.1 Lifting the Transmitter Module into Position and Temporary Attachment

The transmitter module weighs approximately 11.5kg (24 lb), which may require handling by a two persons. Remove all plastic caps from the connectors and output waveguide flange. Lift the transmitter module and install it on to the mounting frame opening. The transmitter module is now ready for permanent attachment.

The transmitter is designed to operate in an outdoor environment and is waterproof when mounted in the correct orientation as per Figure 1 and the orientation labels placed on the RF amplifier shroud.

The transmitter contains a high flow-rate fans (300 CFM) for cooling the RF amplifier module. These fans function continuously during the transmitter operation. To provide a sufficient airflow, the transmitter should be mounted with a minimum clearance of 3 inches on all four sides and the bottom. Refer to Figure 1. Adequate cooling for the transmitter will provide years of top performance.

2.4.2 Securing the Transmitter Module

Secure the transmitter module on to the mounting frame using the hardware described in section 2.3.2. Align the transmitter output waveguide flange with the mating flange of the antenna feeder waveguide.Using the O-ring and hardware provided, connect the antenna feeder waveguide. Torque the flange screws to 16 inch-pounds (1.8 N-m). Attach the proper cables for waveguide for IF input, AC power and M&C to the corresponding connectors of the transmitter module. Refer to the model drawing in Appendix A.

NOTE

The cylindrical connectors are labeled clearly and have different pin layouts. Refer to pin out assignments in Appendix C . It is impossible to incorrectly install the mating connectors.

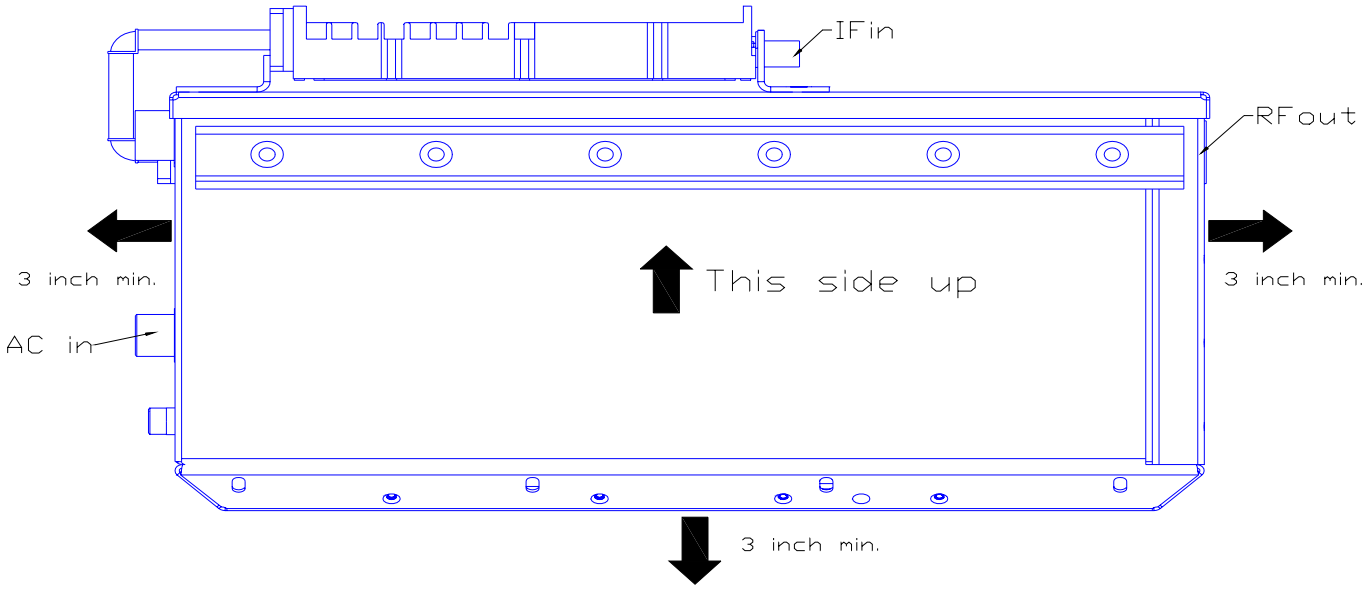

Figure 1 – Recommended Distance for Mounting on the Hub

2.5 Functional Overview

2.5.1 General

This section describes the transmitter module functions in detail. The functional overview explains the RF amplification, monitor & control and power distribution.

Figure 2 block diagram illustrates the transmitter module.

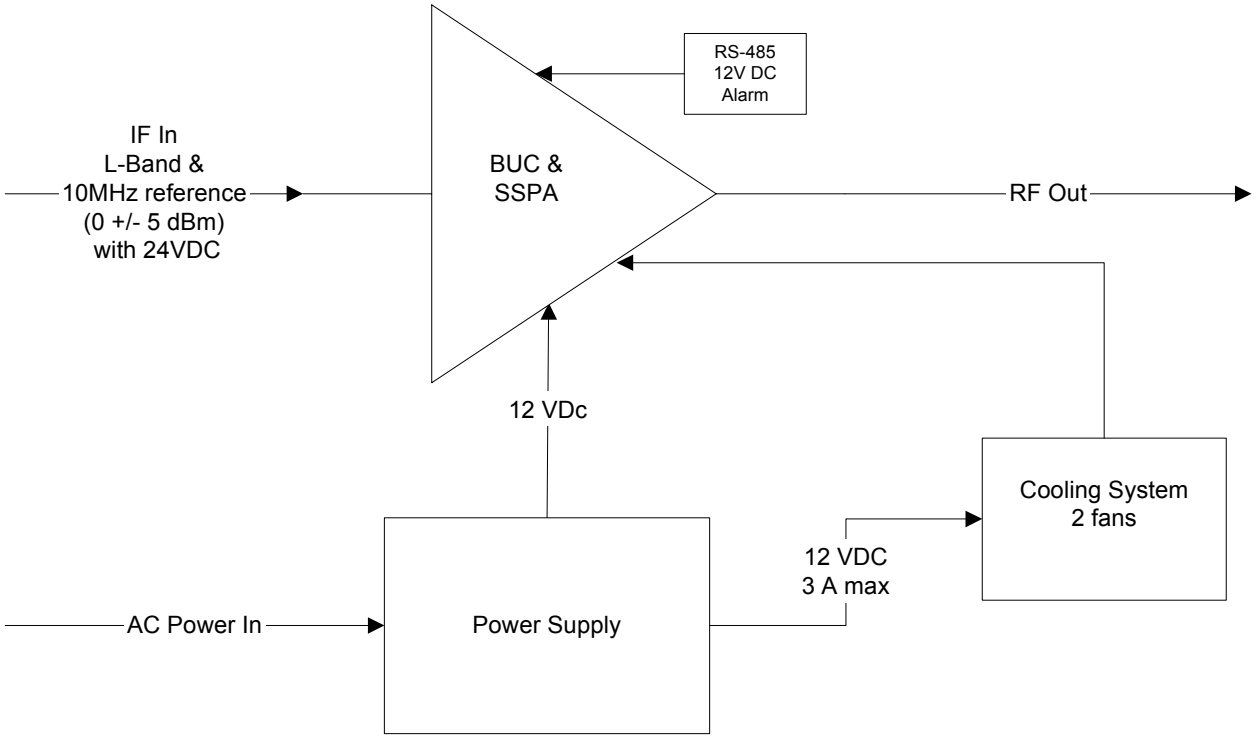

Figure 2 - System Block Diagram for –25, -33, -35

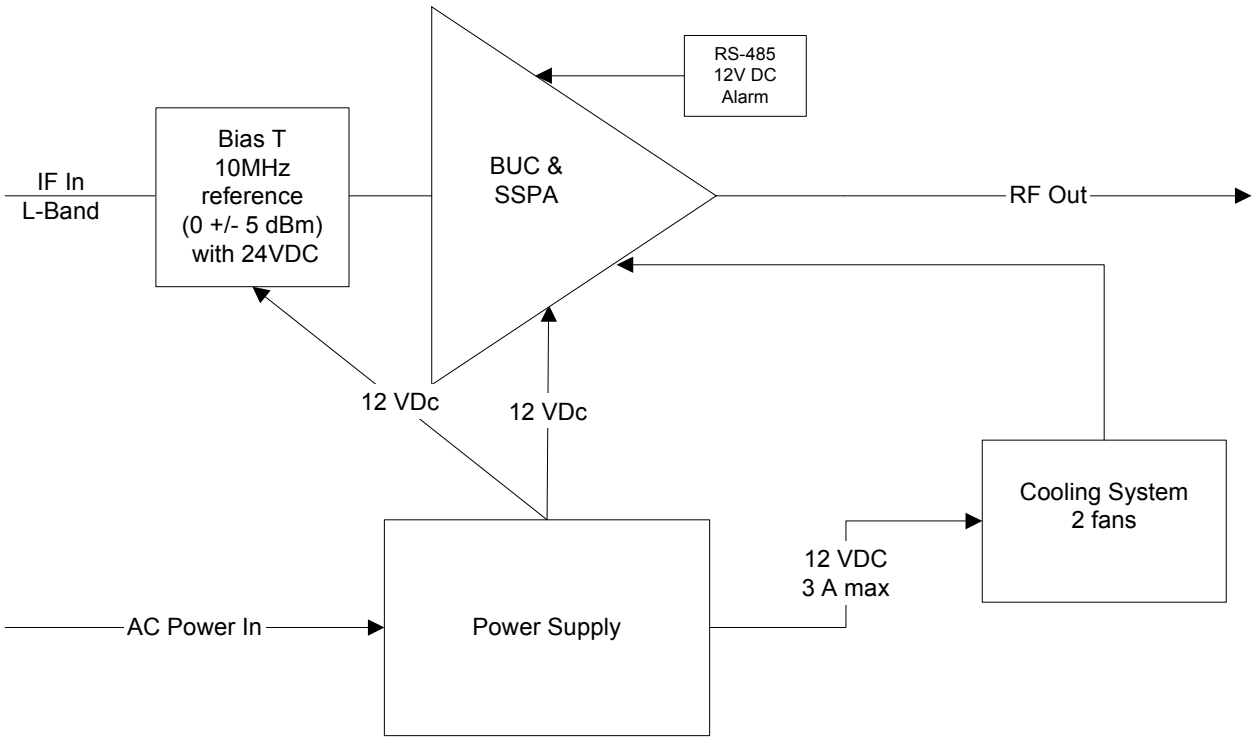

Figure 3 - System Block Diagram -37

2.5.2 IF/RF Conversion and Amplification

The IF Input signal with a 10MHz reference, 0±5dBm and 24VDC, 1.0A nominal enters the BUC by a coaxial cable, converted to Ku-Band by the BUC and goes through an isolator, which provides a good VSWR at the input. Under normal operation, the RF amplifier will amplify the RF Input signal level up to a power level of 42 to 45 dBm (16 to 30 Watts CW) P1dB minimum. For small signal gain, the transmitter module is capable of providing a gain of approximately 70 dB.

To achieve the rated output power, GaAs transistors, as well as other microwave components within the RF Amplifier, provide the necessary gain and low insertion loss. The amplified signal is transmitted through the output waveguide section to a satellite up-link system.

2.5.3 Monitor and Control (if applicable)

The transmitter has an RS-485 serial interface. The transmitter can communicate to the indoor unit or redundancy control module via RS-485. RS-485 Protocol Specifications are found in Appendix B, if applicable.

The control system can provide the following M&C functions:

- System Alarm: when an amplifier is not functioning properly, TTL logic will activate an alarm (TTL high: alarm condition). The alarm signal will be transmitted via RS-485 as well as through two analogue wires in order to support the redundancy option.
- Mute Control (via RS-485)
- Mute Control (via hardware line): TTL high level signal will mute a transmitter
- Output Power Monitoring: 15 dB dynamic range (via RS-485)
- Base Plate Temperature Monitoring (via RS-485)

The SSPA can also provide 12VDC (2A max) at the same connector to supply DC power for redundancy control.

2.5.4 Internal Power Distribution Reference

The SSPA operates from power source of 110/220 VAC, 50 Hz to 60 Hz and will consume 1,200-Watts maximum.

CAUTION!

There is an internal slow blowing fuse installed in the power supply module in order to protect the entire system from over current.

- The power supply converts the incoming AC voltage into two separate DC voltages. The DC voltages are regulated to ensure isolation and stability.

3 Operation

This chapter describes the verification of the operation and control of the transmitter module. It shall be performed by authorized personnel prior to maintenance and/or repair.

3.1 Procedure

Verify that the installation procedure described in Chapter 2 was completed. A complete physical check of the customer's system is suggested.

WARNING!

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*The output power available at the output waveguide flange is extremely hazardous. Under **no circumstances** should be transmitter be operated without the waveguide feed or a high power load attached. Do not operate this equipment in the presence of flammable gases or fumes. Failure to observe this precaution will result in personal injury. Safe and careful installation of this transmitter will eliminate the possibility of accidents and provide years of top performance.*

Verify the antenna feed waveguide connection is properly done before the transmitter is energized.

NOTE

The transmitter module can withstand any source or load VSWR. However, the transmitter module will meet all specification requirements only if the source/load VSWR is sufficient. Refer to Section 2.2

Normal operation is not possible if the antenna feeder VSWR is greater than 1.5:1.

Turn ON the power and allow a warm up period of twenty minutes before operating the transmitter module. This will assure stable gain and power. The transmitter module can function with a coupler when a direct measurement of the output power is made.

CAUTION!

It is strongly recommended not to exceed -20 dBm maximum RF Input level. The RF amplifier will be in deep saturation if overdriven. RF performance will degrade significantly, and proper operation is not possible. This operational condition is the survival mode for the transmitter module. Never exceed the maximum safe RIF Input level of -10dBm (100 mW) or permanent damage to the transmitter module may result.

Verify the status of the System Fail signal from the M&C interface using the RS-485 protocol. (Protocol description is attached to this manual.)

3.2 Interface

The connector interface is described in Appendix C. The serial interface, if applicable, is documented in Appendix B.

4 Maintenance

This chapter contains information on how to maintain, troubleshoot and repair the transmitter module. The transmitter module is extremely reliable, requiring very little preventive maintenance, or repair. Should there be a malfunction, this chapter also contains technical information to help diagnose basic failures.

4.1 Preventive Maintenance

4.1.1 Procedure

WARNING!

Shut down the transmitter module before disassembly and remove all cables and connectors. Failure to observe this precaution may result in personal injury or death. This includes the removal of any RF power originating from other system components.

When the transmitter module is in the hot stand-by mode in a redundant system, switch it to the operation mode at least once every three months. Make sure the fan is running while in operation mode.

When the transmitter module is in the cold stand-by mode in a redundant system, switch it to the operation mode at least once every three months. Make sure the fan is running while in operation mode.

4.1.2 Transmitter Module Cooling System Preventive Maintenance

Preventive maintenance is limited to checking the performance of the transmitter module cooling system. No electrical or mechanical adjustments are required for normal operation.

The fan is the least reliable item in the transmitter module. Wearing of the fan bearings will cause the RPM to drop and will create a higher than average heat-sink temperature. It is recommended to replace the fan after 2 years of operation.

The Cooling system was designed so that the fan can be replaced easily in the field. Refer to Figure 4 below.

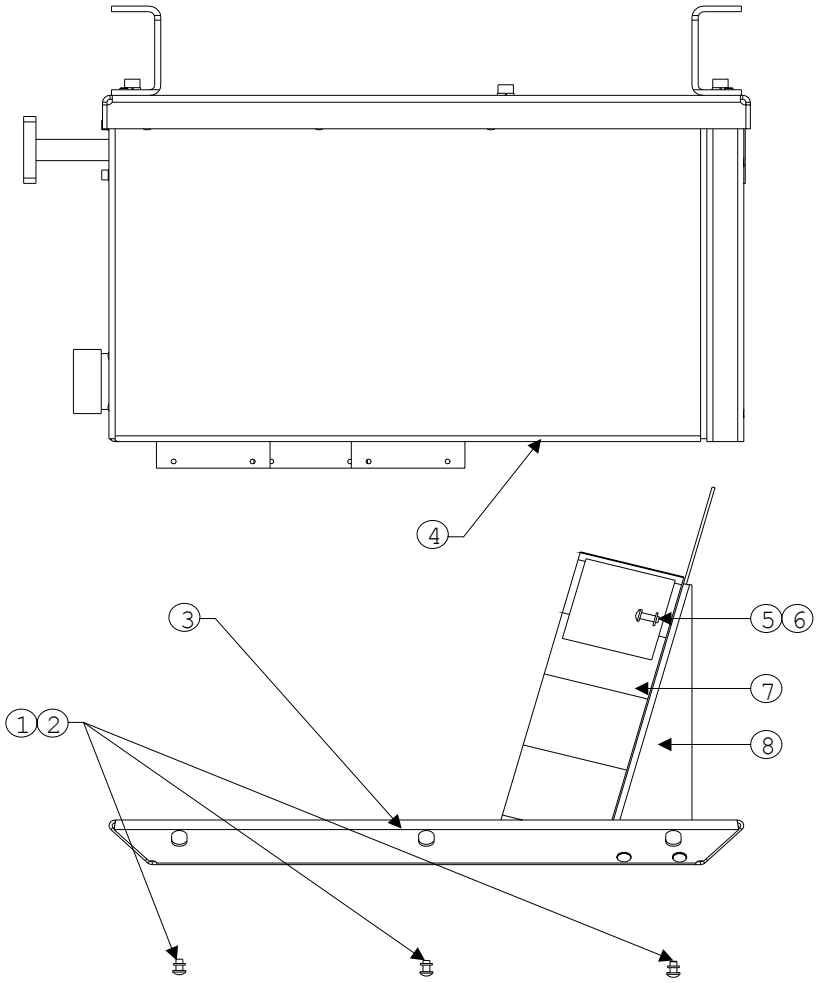

Figure 4 – Cooling Fan Replacement

To replace the fan, perform the following:

1. Remove six screws (1) and six lockwashers (2) from the bottom shroud (3)
2. Remove bottom shroud (3) with attached fan (7) and fan holder (8) from the transmitter (4)
3. Disconnect wires of fan (7) to transmitter (4)
4. Remove four screws (5) and four lockwashers (6)
5. Remove fan (7) from fan holder (8)
6. Using four screws (5) and four lockwashers (6), install new fan (7) onto fan holder (8)
7. Connect wires of new fan (7) onto the transmitter (4).
8. Using six screws (1) and six lockwashers (2), reinstall the bottom shroud (3) with the fan (7) and fan holder (8) on to transmitter (4).

The transmitter module is now ready for operation and no other periodic maintenance is required.

4.1.3 Performance Check

Verify the system is properly set up as per Chapters 2 and 3. The power output at 1dB compression shall be measured for evaluating the performance of the transmitter module.

It is recommended to measure the following parameters for ensuring that the transmitter module is in good working condition:

- Gain and Gain flatness
- RF load VSWR and RF source VSWR
- Two-Tone Intermodulation Distortion
- Return Loss at connectors J1 and J2 of the TRANSMITTER MODULE

Using a Source and an IF input signal level within the small signal region of the transmitter module, measure the power level at connectors J1 and J2. See Figure 4. Plot the swept response on a test data sheet. From the plot, determine gain and gain flatness.

With an IF Input signal level within the small signal region of the transmitter module, measure the VSWR (Return Loss) at connectors J1 and J2. See Figure 4. Plot the swept return loss for both the IF Input and RF Output signals on a test data sheet. From the plot determine the return loss.

From the output power measurements determine P1dB. Record value on a test data sheet.

Measure the Two-tone Intermodulation Suppression using two equal signals separated by 5 MHz. Record value on test data sheet.

4.1.4 Troubleshooting

WARNING!!

Cable connection and disconnection shall be done carefully to avoid physical damage to the cables and connectors, which may cause intermittent problems in the future.

Use Table 1 to quickly isolate a fault within the transmitter module. If the transmitter module is defective, notify Mitec and follow the process detailed in section 1.1.2.

Symptom	Action
Fails performance test	Check power source, RF source, cabling and connectors. Check for clogged fan and debris in heat-sink fins. Clean thoroughly. If fan is worn, replace fan. If correct, transmitter module is defective. Return transmitter module to Mitec.

Table 2 - Recommended Corrective Actions

4.1.5 Out-of Warranty Repair

A non-warranty and out-of-warranty repair service is available from **Mitec** for a nominal charge. The customer is responsible for paying the cost of shipping the SSPA both to and from **Mitec** for these repairs.

Appendix A

Drawings & Schematic Diagrams

16 to 30 Watt, 70 dB Gain, Ku Band ODU High Power Transmitter Module - Outline Drawings

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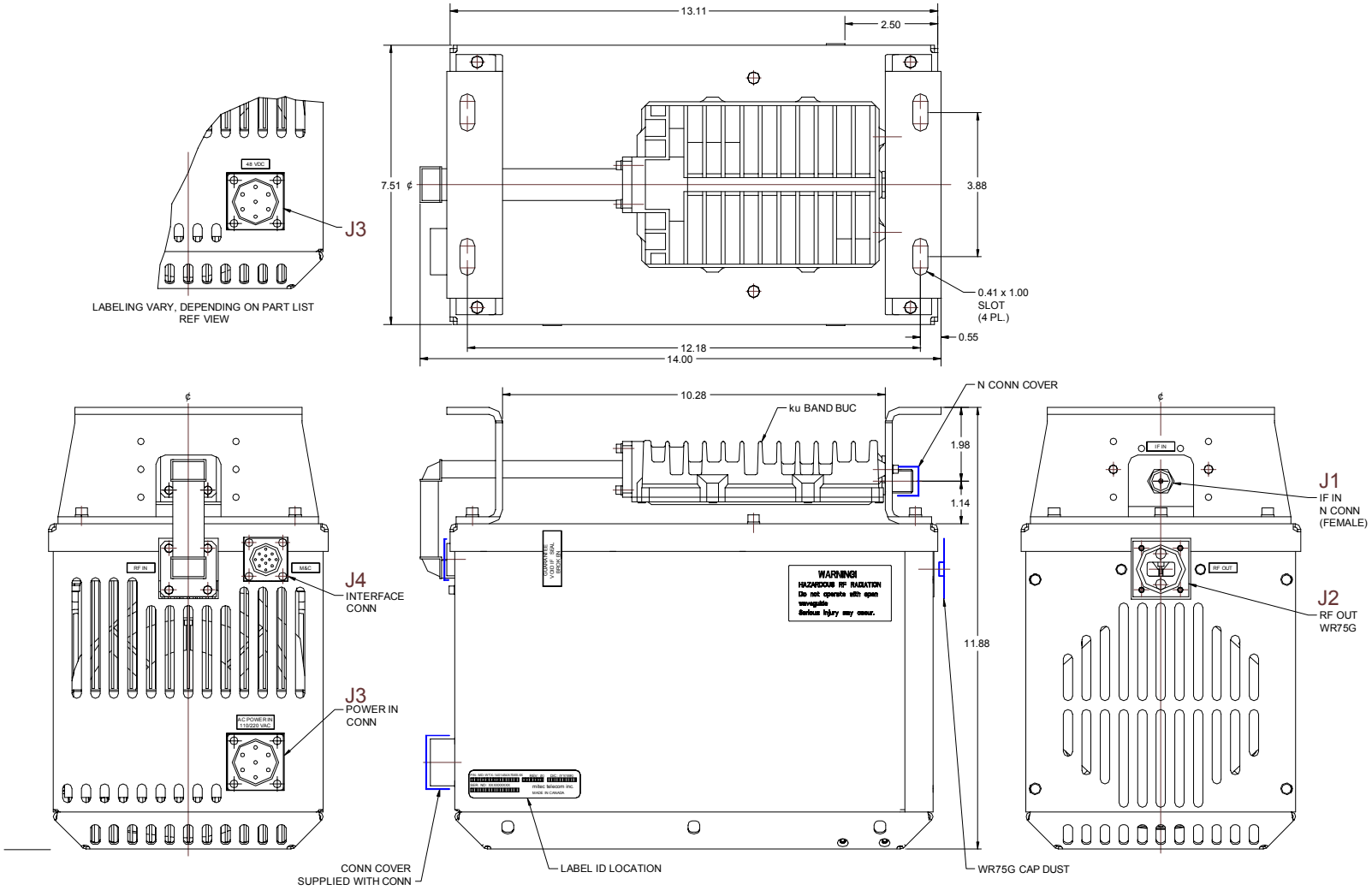

Figure 5 – WTX-14014542_43_44-70-ES-xx Outline drawing

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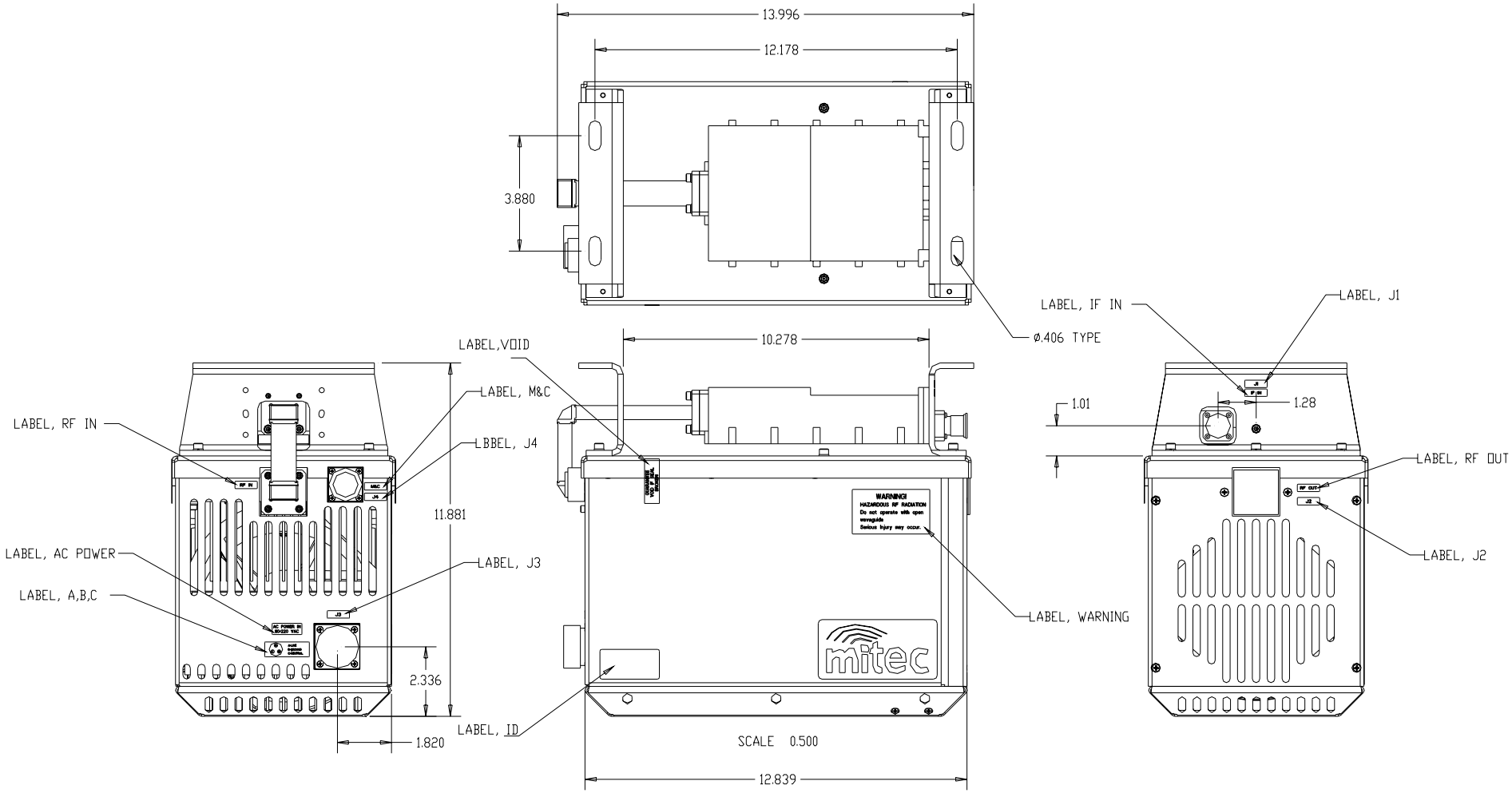

Figure 6 - WTX-13714542_43_44-70-ES-xx Outline drawing

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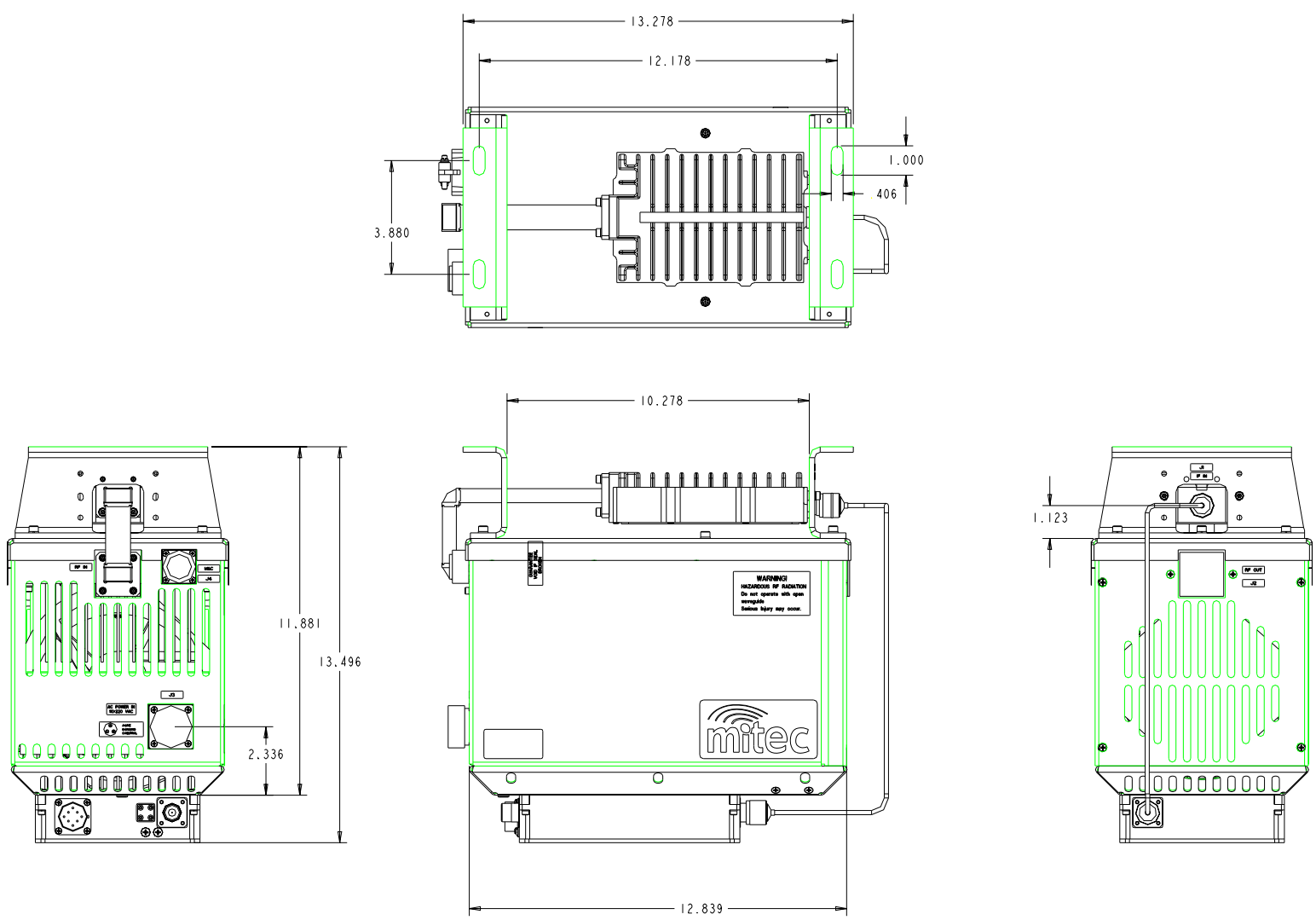

Figure 7 - WTX-14014545-70-ES-37 Outline drawing

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Appendix B

Serial Protocol

Appendix B contains information of the RS-485 Serial Protocol, if applicable.

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Revision	Date	Change Summary	Approval
0A	22-Apr-2003	Preliminary specification sent to customer.	C. Villeneuve
0B		Document does not exist.	
0C		Document does not exist.	
0D	04-Dec-2003	Extracted protocol specs from technical specs document.	C. Villeneuve
0E	16-Jan-04	Completely revamped the document format. No functional changes made.	C. Villeneuve
01	10-May-2007	Added attenuation control command.	C. Villeneuve

Serial Communication Protocol Specification
For
Control Software 3900040-00

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1 Document legend

Text in this document highlighted in grey identifies features which are planned but not implemented yet.

2 Project Overview

This document describes the communications protocol used to communicate with high-power transmitter modules (ODUs) configured with embedded software 3900040-00 when used in a stand-alone configuration.

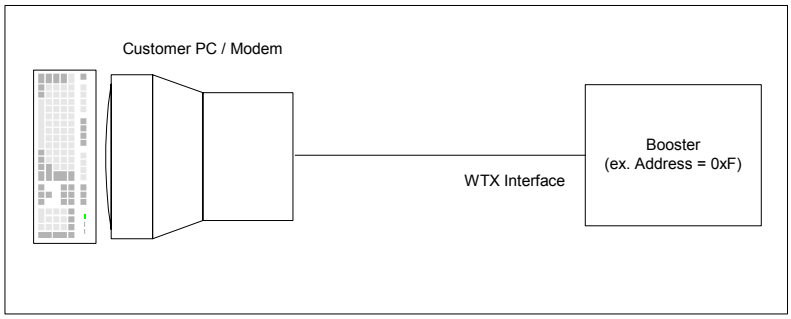


Figure 1) System Block Diagram

If the Booster is configured in a redundant configuration, then the communications protocol for the redundant kit supercedes the present document.

3 Definitions and acronyms

The following terms appear throughout this document:

Controller:	The microprocessor-based card and associated embedded software which handles all communications between the customer interface and the amplifier.
CRC:	Cyclic Redundancy Check
Customer Interface Port:	The interface port through which the device used by the customer will interact with the Transceiver (ie. typically a modem or PC).
Customer Interface Device:	The interface device used by the customer to interact with the Transceiver (ie. typically a modem or PC).
PC:	Personal Computer.
RF:	Radio Frequency.
SCI:	Serial Communications Interface.
WBT:	Wavesat Bias Tee Unit
WTX:	Wavesat Transmitter

4 Scope

This document covers all aspects of the communication protocol which are required for the customer to develop a controlling device (typically a PC application program or modem) to interface with the Mitec product.

5 Serial Communications Link Interface

5.1 Customer Interface Port Configuration

The customer interface port of the controller is configured as follows:

Baud Rate:	19200bps
Data bits:	8
Stop bits:	1
Parity:	None
HW Control	None

5.2 Customer Interface Cable Connections

This software protocol remains the same regardless of the transport medium used (ie RS232, RS485 half duplex or RS485 full duplex). This section defines the wiring required to communicate with the Mitec product.

Note that the pin numbers on both side of the cable are deliberately omitted since these will vary depending on the Mitec product as well as the PC / Modem interface. Please refer to the specific user manuals for pin allocations.

Please refer to the user manual for the Mitec product if unsure of the customer interface transport medium.

For RS232:

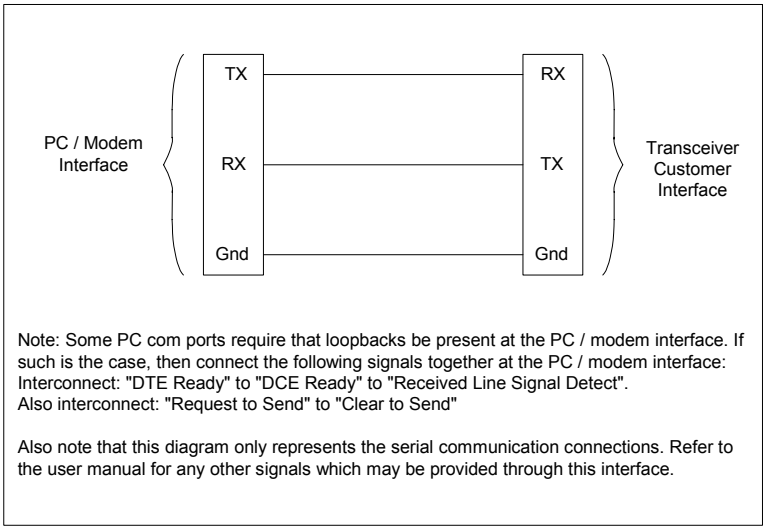

PC / Modem Interface
TX
RX
Gnd
RX
TX
Gnd
Transceiver Customer Interface
Note: Some PC com ports require that loopbacks be present at the PC / modem interface. If such is the case, then connect the following signals together at the PC / modem interface:
Interconnect: "DTE Ready" to "DCE Ready" to "Received Line Signal Detect".
Also interconnect: "Request to Send" to "Clear to Send"
Also note that this diagram only represents the serial communication connections. Refer to the user manual for any other signals which may be provided through this interface.

Figure 2) RS232 Customer Interface Wiring

For RS485 Half Duplex:

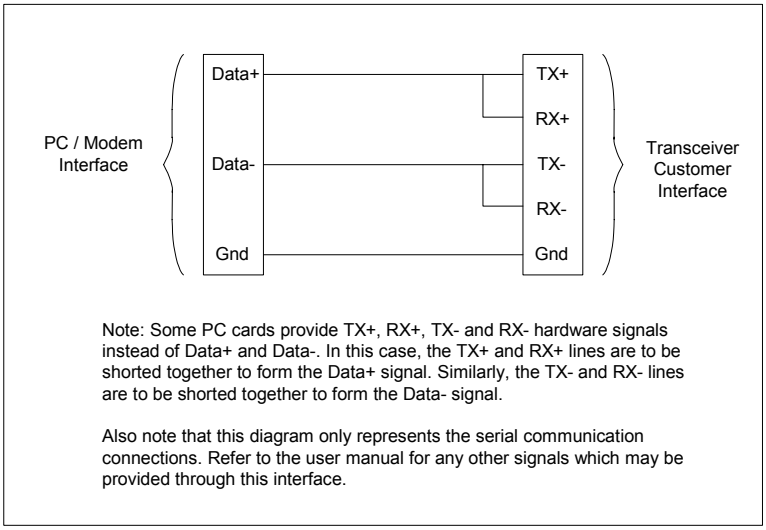

PC / Modem Interface
Data+
Data-
Gnd
TX+
RX+
TX-
RX-
Gnd
Transceiver Customer Interface
Note: Some PC cards provide TX+, RX+, TX- and RX- hardware signals instead of Data+ and Data-. In this case, the TX+ and RX+ lines are to be shorted together to form the Data+ signal. Similarly, the TX- and RX- lines are to be shorted together to form the Data- signal.
Also note that this diagram only represents the serial communication connections. Refer to the user manual for any other signals which may be provided through this interface.

Figure 3) RS485 Half Duplex Customer Interface Wiring

For RS485 Full Duplex (ie RS422):

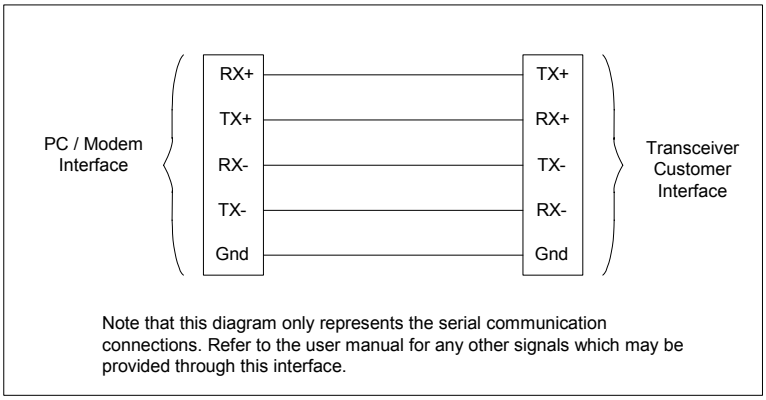


Figure 4) RS485 Full Duplex (ie RS422) Customer Interface Wiring

6 Communication Protocol Framing

6.1 SCI Packet Frame Format

The packets exchanged with the master controller will have the following format (regardless of direction):

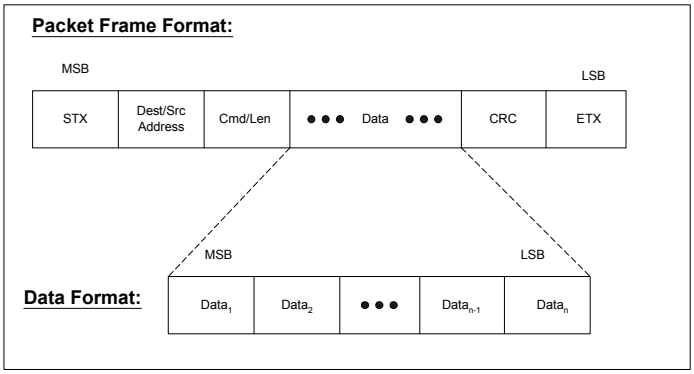


Figure 5) SCI Packet Frame Format

6.1.1 SCI Packet Byte Description

- **STX** is the start transmission byte (defined as 0x7E). This byte is used to determine the start of a packet.

- **Dest/Src Address** contains the destination address in the high nibble and the source address in the low nibble. The destination address is the address of the device which is to process the packet. The source address is the address of the device which sent the packet. Note that the device address of the customer interface device is always = 0x0F.

- **CMD/Len** contains the packet command in the high nibble and the number of bytes in the data portion of the packet in the lower nibble.

  The following commands may be sent by the customer interface device:

GET (command high nibble = 0x0)	Request the current value of a database element.
SET (command high nibble = 0x1)	Set the database element to the specified value.

  The following commands may be returned to the customer interface device:

UPD (command high nibble = 0x8)	Return the current value of a database element.
ACK (command high nibble = 0xE)	Acknowledge a received packet.
NACK (command high nibble = 0xF)	Reject a received packet (Not ACKnowledge).

- **$Data_1$ - $Data_n$** contains the packet payload. The value of the data bytes is specific to the command and will be covered in following sections.

- **CRC** is the cyclic redundancy check and is calculated by performing a byte-wise exclusive OR of the Dest/Src address byte, Cmd/Len byte and all data bytes. A bit-wise inversion is then applied to the CRC before being inserted into the packet.

- **ETX** is the end transmission byte (defined as 0x7F). This byte is used to determine the end of a packet.

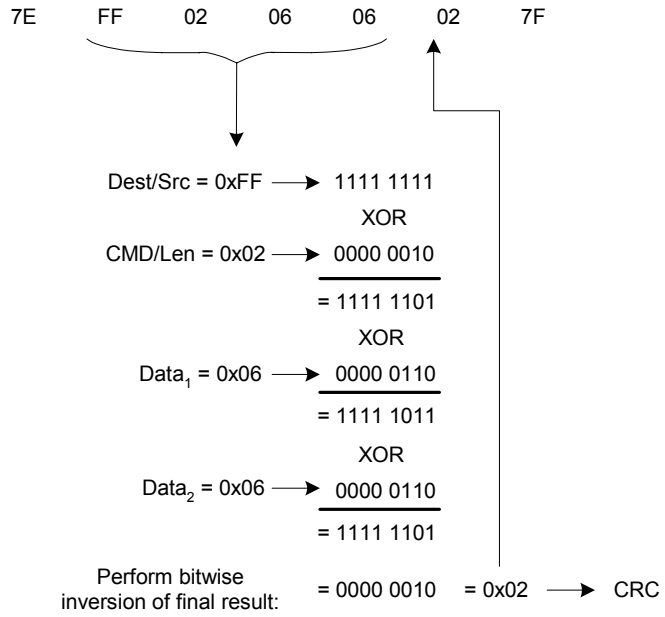
6.1.2 Default Address Values

The customer interface device must always be assigned address 0xF.

The Booster device address is factory defaulted to 0xF. It may be set by the customer using the SET Booster Address command (refer to SET Control Command List).

6.1.3 CRC Calculation Example

To send a command to read the temperature (database element = 0x0606) from the Booster (device address 0x0F), the command is:



6.1.4 Command / Reply Packet Sequencing

The Booster will never send a packet to the customer interface device unless a command is received. In other words, the Booster will not speak unless spoken to.

7 Command List

7.1 Default Reply Packet Format

This section identifies the packet format the ACK (Acknowledge) and NACK (Not acknowledge) replies which may be sent to the customer interface device in response to a received command.

NOTE: The packets shown in the list below are based on the assumption that the Booster device address is set to 0xF. To modify the commands for different addresses, the Dest/Src byte and the CRC byte will have to change in all packets.

Reply	Packet Format	Explanation	Interpretation	Examples
ACK (Acknowledge)	7E FX E0 ZZ 7F	Acknowledge that the received packet was properly processed.	X = Device address of the packet source device. ZZ = CRC.	1) reply: 7E FF E0 E0 7F (ACK reply sent from the Booster)
NACK (Not Acknowledge)	7E FX F1 YY ZZ 7F	Indicate that a problem was encountered with the received packet.	X = Device address of the packet source device. YY = Error code (03 = Incorrect CRC 18 = Unrecognized command 30 = Set command attempted on a restricted database element) ZZ = CRC.	1) reply: 7E FF F1 03 F2 7F (NACK reply sent from the Booster for an invalid CRC) 2) reply: 7E FF F1 18 E9 7F (NACK reply sent from the Booster for an unrecognized command).

7.2 GET Status Command List

This section identifies the list of commands available to query any unit for status information.

NOTE: The packets shown in the list below are based on the assumption that the Booster device address is set to 0xF. To modify the commands for different addresses, the Dest/Src byte and the CRC byte will have to change in all packets.

Command	Packet Format	Explanation	Possible Replies	Interpretation	Examples
Get Booster Temperature	7E FF 02 06 06 02 7F	Query booster for current temperature	**Update Booster Temp:** 7E FF 84 06 06 TT TT ZZ 7F	TT TT = Booster temp in ^{o}C + 273. ZZ = CRC.	1) cmd: 7E FF 02 06 06 02 7F reply: 7E FF 84 06 06 01 02 87 7F (Temp = 0x0102 = 0d258 – 273 = -15^{o}C) 2) cmd: 7E FF 02 06 06 02 7F reply: 7E FF 84 06 06 01 34 B1 7F (Temp = 0x0134 = 0d308 – 273 = +35^{o}C)
			NACK	Refer to 7.1.	
Get Booster Temperature Sensor Voltage	7E FF 02 2F FF D2 7F	Query booster for current temperature sensor voltage (Note: This command is to be used if a more accurate temperature reading is required than the result of the "Get Booster Temperature" command.)	**Update Booster Temp Sensor:** 7E FF 84 2F FF VV VV ZZ 7F	VV VV = Booster temp sensor voltage from 0V (0x0000) to +5V (0x03FF). The conversion formula is: Temp = (Voltage x 0.4883) – 273. ZZ = CRC.	1) cmd: 7E FF 02 2F FF D2 7F reply: 7E FF 84 2F FF 02 06 50 7F (Voltage = 0x0206 = 0d518. Temp = (518 x 0.4883) – 273 = -20.1^{o}C) 2) cmd: 7E FF 02 2F FF D2 7F reply: 7E FF 84 2F FF 02 76 20 7F (Voltage = 0x0276 = 0d630. Temp = (630 x 0.4883) – 273 = +34.6^{o}C)
			NACK	Refer to 7.1.	
Get Booster Output Power	7E FF 02 17 FF EA 7F	Query booster for current output power	**Update Booster Output Power:** 7E FF 84 17 FF PP PP ZZ 7F	PP PP = Output power in 10 x dBm. ZZ = CRC.	1) cmd: 7E FF 02 17 FF EA 7F reply: 7E FF 84 17 FF 01 2C 41 7F (Power = 0x012C = 0d300 = 30.0dBm.) 2) cmd: 7E FF 02 17 FF EA 7F reply: 7E FF 84 17 FF 01 A0 CD 7F (Power = 0x01A0 = 0d416 = 41.6dBm.)
			NACK	Refer to 7.1.	
Get Booster Gain (if applicable)	7E FF 02 18 FF E5 7F	Query booster for current gain	**Update Booster Gain:** 7E FF 84 18 FF GG GG ZZ 7F	GG GG = Gain in 10 x dB. ZZ = CRC.	1) cmd: 7E FF 02 18 FF E5 7F reply: 7E FF 84 18 FF 02 08 69 7F (Gain = 0x0208 = 0d520 = 52.0dB.) 2) cmd: 7E FF 02 18 FF E5 7F reply: 7E FF 84 18 FF 01 95 F7 7F (Gain = 0x0195 = 0d405 = 40.5dB.)
			NACK	Refer to 7.1.	

Command	Packet Format	Explanation	Possible Replies	Interpretation	Examples
Get Mute Status	7E FF 02 06 01 05 7F	Query booster for mute status	**Update Mute Status:** 7E FF 84 06 01 00 MM ZZ 7F	MM = Mute status (0 = enabled; 1 = muted) ZZ = CRC.	1) cmd: 7E FF 02 06 01 05 7F reply: 7E FF 84 06 01 00 00 83 7F (Booster is enabled.) 2) cmd: 7E FF 02 06 01 05 7F reply: 7E FF 84 06 01 00 01 82 7F (Booster is muted.)
			NACK	Refer to 7.1.	
Get IF Frequency	7E FF 02 16 FF EB 7F	Query transceiver for IF frequency	**Update IF Frequency:** 7E FF 84 16 FF XX XX ZZ 7F	XX XX = System IF frequency in MHz. ZZ = CRC.	1) cmd: 7E FF 02 16 FF EB 7F reply: 7E FF 84 16 FF 03 B6 D8 7F (IF frequency set to 0x03B6 = 0d950 = 950 MHz)
			NACK	Refer to 7.1.	
Get Booster SW Version Base number (MSB)	7E FF 02 05 FC FB 7F	Query booster for SW version base MSB	**Update SW Version Base MSB:** 7E FF 84 05 FC 39 00 44 7F	SW version base number MSB is always 0x3900.	1) cmd: 7E FF 02 05 FC FB 7F reply: 7E FF 84 05 FC 39 00 44 7F cmd: 7E FF 02 05 FD FA 7F reply: 7E FF 84 05 FD 00 40 3C 7F cmd: 7E FF 02 05 FE F9 7F reply: 7E FF 84 05 FE 00 00 7F 7F cmd: 7E FF 02 05 FF F8 7F reply: 7E FF 84 05 FF 30 31 7F 7F The resulting software version is: 3900040-00-R01
			NACK	Refer to 7.1.	
Get Booster SW Version Base number (LSB)	7E FF 02 05 FD FA 7F	Query booster for SW version base LSB	**Update SW Version Base LSB:** 7E FF 84 05 FD XX XX ZZ 7F	XX XX = SW version base number (LSB). ZZ = CRC.	
			NACK	Refer to 7.1.	
Get Booster SW Version Configuration	7E FF 02 05 FE F9 7F	Query booster for SW version configuration	**Update SW Version Config:** 7E FF 84 05 FE 00 XX ZZ 7F	XX = SW version configuration. ZZ = CRC.	
			NACK	Refer to 7.1.	
Get Booster SW Version Revision	7E FF 02 05 FF F8 7F	Query booster for SW version revision	**Update SW Version revision:** 7E FF 84 05 FF RR RR ZZ 7F	RR RR = SW version revision represented as two ASCII characters. ZZ = CRC.	
			NACK	Refer to 7.1.	
Get Booster Device Address	7E FF 02 03 04 05 7F	Query booster for device address	**Update booster device address:** 7E FF 84 03 04 00 XX ZZ 7F	XX = Booster device address. ZZ = CRC.	1) cmd: 7E FF 02 03 04 05 7F reply: 7E FF 84 03 04 00 0A 89 7F (Booster device address = 0xA) 2) cmd: 7E FF 02 03 04 05 7F reply: 7E FF 84 03 04 00 FF 7C 7F (Booster device address = 0xF)
			NACK	Refer to 7.1.	
Get Attenuation Setting (if applicable)	7E FF 02 03 07 06 7F	Query booster for attenuation setting	**Update Attenuation Setting:** 7E FF 84 03 07 00 XX ZZ 7F	XX = Attenuation in 0.1 dB. ZZ = CRC.	1) cmd: 7E FF 02 03 07 06 7F reply: 7E FF 84 03 07 00 64 E4 7F (Attenuation set to 0x64 = 0d100 = 10.0 dB)
			NACK	Refer to 7.1.	

7.3 GET Alarms Command List

This section identifies the list of commands available to query any unit for alarm information.

NOTE: The packets shown in the list below are based on the assumption that the Booster device address is set to 0xF. To modify the commands for different addresses, the Dest/Src byte and the CRC byte will have to change in all packets.

Command	Packet Format	Explanation	Possible Replies	Interpretation	Examples
Get Booster Over Temperature Alarm	7E FF 02 00 02 00 7F	Query booster for over temperature alarm	**Update booster over temperature alarm:** 7E FF 84 00 02 00 XX ZZ 7F	XX = Alarm state (0x00 = no alarm; 0x11 = alarm) ZZ = CRC.	1) cmd: 7E FF 02 00 02 00 7F reply: 7E FF 84 00 02 00 11 97 7F (Booster over temp alarm is raised)
			NACK	Refer to 7.1.	2) cmd: 7E FF 02 00 02 00 7F reply: 7E FF 84 00 02 00 00 86 7F (Booster over temp alarm is clear)
Get Booster Low Power Alarm (if applicable)	7E FF 02 00 05 07 7F	Query booster for low power alarm	**Update booster low power alarm:** 7E FF 84 00 05 00 XX ZZ 7F	XX = Alarm state (0x00 = no alarm; 0x11 = alarm) ZZ = CRC.	1) cmd: 7E FF 02 00 05 07 7F reply: 7E FF 84 00 05 00 11 90 7F (Booster low power alarm is raised)
			NACK	Refer to 7.1.	2) cmd: 7E FF 02 00 05 07 7F reply: 7E FF 84 00 05 00 00 81 7F (Booster low power alarm is clear)
Get Booster Summary Alarm	7E FF 02 00 0F 0D 7F	Query booster for summary alarm	**Update booster summary alarm:** 7E FF 84 00 0F 00 XX ZZ 7F	XX = Alarm state (0 = no alarm; 1 = alarm) ZZ = CRC.	1) cmd: 7E FF 02 00 0F 0D 7F reply: 7E FF 84 00 0F 00 01 8A 7F (Booster summary alarm is raised)
			NACK	Refer to 7.1.	2) cmd: 7E FF 02 00 0F 0D 7F reply: 7E FF 84 00 0F 00 00 8B 7F (Booster summary alarm is clear)

7.4 SET Control Command List

This section identifies the list of commands available to set control parameters any unit.

NOTE: The packets shown in the list below are based on the assumption that the Booster device address is set to 0xF. To modify the commands for different addresses, the Dest/Src byte and the CRC byte will have to change in all packets.

Command	Packet Format	Explanation	Possible Replies	Interpretation	Examples
Set Mute Control	7E FF 14 13 01 00 MM ZZ 7F	Mute / Unmute the up link. MM = Mute control (1 = Mute; 0 = enable) ZZ = CRC	**ACK**	Refer to 7.1.	1) cmd: 7E FF 14 13 01 00 01 07 7F reply: ACK (Mute up link) 2) cmd: 7E FF 14 13 01 00 00 06 7F reply: ACK (Enable up link)
			NACK	Refer to 7.1.	
Set IF Frequency	7E FF 14 16 FF XX XX ZZ 7F	Set up link frequency XX XX = Frequency in MHz. ZZ = CRC	**ACK**	Refer to 7.1.	1) cmd: 7E FF 14 16 FF 03 B6 48 7F reply: ACK (Set IF frequency to 950 MHz = 0x3B6) 2) cmd: 7E FF 14 16 FF 04 33 CA 7F reply: ACK (Set IF frequency to 1075 MHz = 0x433) 3) cmd: 7E FF 14 16 FF 04 B0 49 7F reply: ACK (Set IF frequency to 1200 MHz = 0x4B0) 4) cmd: 7E FF 14 16 FF 05 2D D5 7F reply: ACK (Set IF frequency to 1325 MHz = 0x52D) 5) cmd: 7E FF 14 16 FF 05 AA 52 7F reply: ACK (Set IF frequency to 1450 MHz = 0x5AA)
			NACK	Refer to 7.1.	
Set Booster Device Address	7E FF 14 03 04 00 XX ZZ 7F	Set booster device address (0 ≤ address ≤ 0xE)	**ACK**	Refer to 7.1.	1) cmd: 7E FF 14 03 04 00 0A 19 7F reply: ACK (Set Booster device address to 0xA) 2) cmd: 7E FF 14 03 04 00 0E 1D 7F reply: ACK (Set Booster device address to 0xE)
			NACK	Refer to 7.1.	
Set Booster Attenuation (if applicable)	7E FF 14 03 07 00 XX ZZ 7F	Set booster attenuation XX = Attenuation to set in 0.1 dB (range from 0 to 20 dB) ZZ = CRC	**ACK**	Refer to 7.1.	1) cmd: 7E FF 14 03 07 00 00 10 7F reply: ACK (Set Booster attenuation to 0 dB) 2) cmd: 7E FF 14 03 07 00 9B 8B 7F reply: ACK (Set Booster attenuation to 0x9B = 0d155 = 15.5 dB)
			NACK	Refer to 7.1.	

Appendix I: Troubleshooting Guide

Problem	Possible Remedies
No response at all from Booster	1) Ensure the cable assembly is wired properly (refer to 5.2Customer Interface Cable Connections) and that it is properly connected between the transceiver customer interface port and the customer device. 2) Verify that the com port parameters are as specified in 5.1Customer Interface Port Configuration. 3) Confirm that the customer interface cable is connected to the correct PC com port. 4) Ensure that there are no other applications executing on the same com port. 5) If the transport medium is RS232, then connect the loopbacks identified in the note in Figure 2) RS232 Customer Interface Wiring. 6) If using a Booster address other than 0xF, then send a "GET Booster Device Address" command to destination address 0xF. The reply will contain the current booster address. Note that the booster will respond to all commands received with destination address 0xF. 7) If the transport medium is RS485 half duplex, note that some PC cards require software control of the RS485 transmit and receive buffer enable lines. The software in the customer device may need to coordinate the enabling /disabling of these buffers. 8) Ensure the booster is powered on.
Reply packet is incomplete.	1) If software control of the transmit and receive buffer enable lines is required (RS485 half duplex), then it is possible that the timing between the transition needs to be adjusted.

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Appendix C

Interface

Appendix C contains the interface for the unit that this manual accompanies.

Connector Name	Type	Pin #	Signal Name	Description	Parameter
J1 "IF INPUT"	N-Type Female	N/A	IF In	IF Input 24 VDC IN 10 MHz Ref. In	For specifications refer to tables in section 2.2.
J2 "RF OUTPUT"	WR75G	N/A	RF Out	RF Output	For specifications refer to tables in section 2.2.
J3 "AC INPUT"	MS3112E14-12P	A	Line	Line	For specifications refer to tables in section 2.2.
		B	GND	Ground	
		C	Neutral	Neutral	

Figure 8 - Pin out assignments for WTX-1XX145XX-70-ES-25

Connector Name	Type	Pin #	Signal Name	Description	Parameter
J1 "IF INPUT"	F-Type Female	N/A	IF In	IF Input 24 VDC IN 10 MHz Ref. In	-25 dBm, max 24 VDC, 1.5 Amax 0 to ±5 dBm
J2 "RF OUTPUT"	WR 75G	WR75 Grooved	N/A	RF Out	45 dBm max
J3 "AC INPUT"	MS3102R20-15P	A	L	Line	110/220VAC 50 - 60 Hz
		B	GND	Ground	
		C	N	utral	

Figure 9 - Pin out assignments for WTX-1XX145XX-70-ES-26

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Connector Name	Type	Pin #	Signal Name	Description	Parameter
J1 “IF IN”	N-type female	N/A	IF In	IF Input 24 VDC IN 10 MHz Ref. In	For specifications refer to tables in section 2.2.
J2 “RF OUT”	WR75G	N/A	RF Out	RF Output	For specifications refer to tables in section 2.2.
J3 “RS-232”	MS3122E14-12P 12 pins male	A	TX	RS-232	
		B	NC		
		C	RX		
		D	NC		
		F	Al_Sum	Summary Alarm	TTL low-alarm
		H	M_I	Mute In	Mute – high muted
		G	GND	Ground	Signal Ground
		L	+12DC	+12VDC	12VDC 3.5A
		J	**GND**	**Ground**	
J4 “AC Power”	MS3102E20-15P 7 pins male	A	Line	Line	110/220VAC 350W
		B	GND	Ground	
		C	Neutral	Neutral	

Figure 10 - Pin out assignments for WTX-1XX145XX-70-ES-33

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Connector Name	Type	Pin #	Signal Name	Description	Parameter
J1 “IF INPUT”	N-Type Female	N/A	IF In	IF Input 24 VDC IN 10 MHz Ref. In	For specifications refer to tables in section 2.2.
J2 “RF OUTPUT”	WR 137G	WR75Grooved	N/A	RF Out	For specifications refer to tables in section 2.2.
J3 “AC INPUT”	MS3102R 20-15P	A	L	Line	For specifications refer to tables in section 2.2.
		B	GND	Ground	
		C	N	Neutral	
J4 ”RS-485”	MS3112E 14-12P	A	TX+(output to)	RS-485	RS-485 Interface Half Duplex
		B	TX-		
		C	RX+(input from)		
		D	RX-		
		E	AL_Sum_NO	Summary Alarm Normally Open	Pin E Opens Fron Pin H on Alarm
		F	AL_Sum	System_Alarm	Alarm TTL Low
		G	GND	Ground	Signal GND
		H	AL_Sum_Comm	Alarm Common	Floating
		J	GND	Ground	DC GND
		K	M_I	Mute In	To Mute short Pin K to Pin M
		L	+12V	+12 VDC Out	+12 VDC
		M	M_I_Com	Mute In Common	

Figure 11 - pin out assignments for WTX-1XX145XX-70-ES-35

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Connector Name	Type	Pin #	Signal Name	Description	Parameter
J1 "IF INPUT"	WTX-14014545-75-ES-37 N-Type Female	N/A	IF In	IF Input	For specifications refer to tables in section 2.2.
	WTX-14014545-75-ES-37F F-Type Female (Optional)				
J2 "RF OUTPUT"	WR 75G	WR75Grooved	N/A	RF Out	For specifications refer to tables in section 2.2.
J3 "AC INPUT"	MS3102R20-15P	A	L	Line	For specifications refer to tables in section 2.2.
		B	GND	Ground	
		C	N	Neutral	
J4 "RS-485"	MS3112E14-12P	A	TX+(output to)	RS-485	RS-485 Interface Half Duplex
		B	TX-		
		C	RX+(input from)		
		D	RX-		
		E	AL_Sum_NO	Summary Alarm Normally Open	Pin E Opens Fron Pin H on Alarm
		F	AL_Sum	System_Alarm	Alarm TTL Low
		G	GND	Ground	Signal GND
		H	AL_Sum_Comm	Alarm Common	Floating
		J	GND	Ground	DC GND
		K	M_I	Mute In	To Mute short Pin K to Pin M
		L	+12V	+12 VDC Out	+12 VDC
		M	M_I_Com	Mute In Common	

Figure 12 - Pin out assignments for WTX-1XX145XX-70-ES-37

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Appendix D

Spare Parts

Appendix D contains a table of recommended spare parts for on-hand replacement. The following sheet can be copied and used as a fax form to order the required spare parts. Please make sure to include all identifying information to facilitate the processing of your order. The order may also be sent via email or regular mail delivery, at the following address.

Mitec Telecom Inc.
3299 Jean-Baptiste-Deschamps
Lachine, QC, H8T 3E4
Canada

Fax: (514)694-3814
Email: sales@Mitectelecom.com

For additional information, please contact our customer service department at:
(514)694-9000 or 1-800-724-3911

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Mitec telecom inc.

designers and manufacturers of telecom & wireless products
ISO 9001 Certified

Spare Parts Order Form

16 to 30 Watt, 70 dB Gain, Ku Band ODU High Power Transmitter Module

From:			
Place By:		**Signature:**	
Telephone:			
Fax		**Email:**	

Part Description	Part Number	Quantity	Unit Price*	Line Total*

* To be completed by **Mitec** Sales Department

Fax to: Customer Service (514)694-3814